11-13-1973

Progress reports for investigation of the impact of a major flood on the fisheries resources and environments of the Chesapeake Bay : for the period September 1, 1972 - June 30, 1973

Virginia Institute of Marine Science

PROGRESS REPORTS

FOR

INVESTIGATION OF THE IMPACT OF A MAJOR FLOOD ON THE FISHERIES RESOURCES AND ENVIRONMENTS OF THE CHESAPEAKE BAY

For the Period

September 1, 1972 - June 30, 1973

Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

November 14, 1973

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SECTION I

ACTIVITIES RELATED TO TROPICAL STORM AGNES

CRUSTACEOLOGY DEPARTMENT

W. A. Van Engel

September 7, 1972

I. Work completed.

a) Estimates of abundance of survivors of the 1971-72 yearclass of blue crabs were made 1) by semi-balloon trawl in channels of the James, York and Rappahannock rivers; 2) by trawl in the channel of the York River at four selected stations (Y10, Y15, Y20 and Y25); 3) by pushnet in shoal water at Gloucester Point.

b) Blue crabs from the Great Wicomico, Rappahannock River and Hampton Roads on the Western Shore of the bay, and from Deep Creek, Nandua Creek and Nassawadox Creek on the Eastern Shore of the bay, were collected July 19-20, for assay of pesticide and heavy metal content.

c) Crab kills in Lower Machodoc Creek (Aug. 19-21) and Killneck Creek (Aug. 26-27) on the south shore of the Potomac River were investigated.

d) Shrimp collected from the lower York River by trawl (April, May and July) and by beach seine (June and July) have been given to the Crustaceology Department for identification and counting.

II. Results

a) No decrease in number of blue crabs of the 1971 yearclass of blue crabs was apparent in trawl surveys of the three rivers examined (Table 1). No data were collected from the James River more recently than August 9. This suggests that mortality subsequent to Storm Agnes was negligible or nonexistent. Movement of crabs 10 to 15 miles downstream occurred within a week of the storm and persisted to early August. Return to a normal situation, with crabs apparently moving back upstream, occurred in the York River by the end of August. The catch of small numbers of crabs in the York River on August 21-22, 1972 is

unexplainable. Large numbers occurred earlier and later and are indicative of a larger than average year class. This permits the prediction that the commercial catch from September 1972 through August 1973 will be larger than average; except that if low dissolved oxygen conditions in the lower portions of the rivers and in the bay persist this fall, crabs will be exposed to stress conditions that could result in a high mortality.

Pushnet samples from VIMS beach have included smaller numbers of crabs of the 1971 yearclass than expected, when compared with results of trawl surveys in channels of the river (Table 2).

A few small crabs of the 1972 yearclass appeared in pushnet samples from VIMS beach on August 30 and more occurred on September 6, 1972. Seven crabs, 7-13 mm wide, were collected on August 30; 21 crabs, 5-17 mm wide were collected on September 6. The occurrence of crabs of the 1972 yearclass is early evidence that some spawning occurred in 1972 and that hatching and survival were successful since Storm Agnes. No appraisal of the magnitude of the yearclass is possible at this time.

b) Total DDT and its metabolites in crab muscle collected July 19 and 20 was well below critical levels (Table 3).

c) The sequence of events leading to the kill of crabs in creeks along the south shore of the Potomac River suggests the presence of a large volume of water with low dissolved oxygen content at the bottom at the mouth of the Potomac river. This body could be one recurring annually, but probably its magnitude and persistence increased by factors related to Storm Agnes.

d) No analyses of the shrimp collections have been made. Samples are accumulating until funds and personnel are made available. The project, carried by another Department, included no provisions for these analyses.

Table 1 Blue Crab Trawl Surveys

1971 - 1972

Revised September 5, 1972

(Catch in replicated trawl hauls separated by commas)
(This table supercedes that included in the Report of August 3)

River station	1971 (June)	1971 (July 6-7)	1972 (June 7)	1972 (July 2-3) *	1972 (Sept 6) *
R40	74	17	7	2	
35	83	282	56	14, 4, 1, 5, 5	11, 13, 5, 11, 4
30	129	416	65	63	63
25	1262	–	89	54	82
20	110	7	20	99, 122, 97, 117, 52	12, 2, 6, 1, 2
15	116	3	5	50	0
11	97	1	28	10	3
05	–	2	11	27, 33, 29, 13, 25 (1d)	39, 11, 14, 19, 4
00	–	7	10	3	31

River station	1971 (June 23-24)	1971 (July 8)	1971 (Aug 4)	1972 (June 5-7)	1972 (June 29-30)	1972 (July 31-Aug 1)	1972 (Aug 21, 22) *	1972 (Aug 28)
P50	8	0	2	0	0	–		
40	0	10	8	1	0	–		
35	3	43		3	1	–		
30	9	65	58	40	0	–		
25	217	227	34	117	65, 43 :	27, 22 :	11 (plus 20 in 4 class)	318, 134 ..
20	42	113	98	99	41, 78 :	118, 111 :	4	159, 78 ..
15	319	62	7	73	90, 16 :	75, 35 :	1	49, 92 ..
10	31	18	55	10	62, 62 :	21, 61 :	–	18, 11 ..
05	–	1	24	10	10	0	5	
00	80 (June 7)	1 (July 12)	315 (Aug 4)	91 (June 12)	10, 21, 42, 20 (4)	3 (d)	2	
C10	19 (June 7)	10 (July 12)		19 (June 12)	–			
C00	1 (June 7)	3 (July 12)		0 (June 12)	–			

River station	1971 (June 3)	1971 (July 15)	1971 (12 Aug)	1972 (June 12-13)	1972 (June 25-26)	1972 (Aug 8-9) *
J36	0	0	4	0	0	–
32	0	2	7	1	0	1
27	1	15	26	2	2	9
24	20	11	10	5	0, 0, 0, 0, 2	2, 2, 2, 1, 2
19	142	45	57	57	16	2
13	118	72	15	75	39 (1d)	7
10-11	–	–	–	–	25, 10, 4, 13, 6	
05	–	14 :	33 ..	101	83	13
00	–	2 :	49 ..	29	11, 13, 50, 102, 68	5
						13, 13, 22, 54, 84

Table 2 — Blue Crab Pushnet Surveys. 1971-1972

Walter Lee
September 5,

Date	1972 Number		1971	1971
			31 March	0
5 April 72	0		7 April	2
12 "	4		14 "	27
19 "	12		21 "	36
26 "	1			
3 May	15		5 May	239
10 "	23		12 "	136
17 "	11		19 "	96
—	—			
31 "	27		26 "	93
7 June	15		2 June	46
14 "	55		9 "	92
22 "	23		16 "	56
28 "	39		23 "	114
5 July	31		30 "	38
13 "	10		7 July	47
20 "	9			
26 "	4			
2 Aug	13		(Data not available at time of report)	
9 "	19			
17 "	6			
23 "	11			
30 "	7			
6 Sept	28			
			8 Sept	12
			15 "	36
			22 "	11
			29 "	9
			6 Oct	9
			13 "	25
			27 "	10
			3 Nov	43
			10 Nov	34

Table 3

MEMORANDUM

TO: W. A. Van Engel DATE: 7 September 1972

FROM: Bob Huggett, Tom Barnard

SUBJECT: Pesticide Analysis: Accomac County crabs collected 19 & 20 July 1972.

The results of the crab samples you submitted for pesticide analysis are as follows:

Sample	Wt.	(PPM) DDE	DDD	DDT
DC-3-M DC-2-M	2.2g	0.01	None	None
F1-5-M	4.6g	0.003	Trace	None
DC-5-M DC-4-M	1.75g	0.007	None	None
MC-5-M	3.2g	0.014	0.006	Trace
MC-4-M	2.0g	0.026	0.013	Trace

B. H., T. A. B.

PLANKTON OF THE LOWER CHESAPEAKE BAY

Summer 1972

(Preliminary)

PROJECT AGNES

G. C. Grant

R. Rhodes

J. E. Warinner

P. L. Zubkoff

September 1972

Virginia Institute of Marine Science

Gloucester Point, Virginia

SUMMARY

PLANKTON OF THE LOWER CHESAPEAKE BAY

I. What has been done

Station E of the Lower York River and the Lower Bay sampling strata (A-H) have been analyzed for the data outlined in Table 1.

Hydrographic, Energetics, and Phytoplankton data (Table1) are completed to a tabulation of the findings.

II. Results

Hydrographic, Energetics, Phytoplankton and Zooplankton results are presently colated in the form of approximately 60 tables.

III. Remains to be done

A. Hydrographic, Energetics and Phytoplankton

(1) Graphic description of results

(2) Interpretation of results

(3) Writing of results

B. Zooplankton

(1) Sorting of remaining samples

(2) Identification to species

(3) Analysis of community changes

(4) Writing of results

IV. Who will do

(1) Hydrographic data
Grant, Warinner, and Zubkoff
(approximately 3 months)

(2) Energetics data
Warinner and Zubkoff
(approximately 3 months)

(3) Phytoplankton data
R. Rhodes
approximately 3 months after Hydrographic and Energetics data is available

(4) Zooplankton data
Grant and Olney
(approximately 1 year)

V. Needs

Approximately 3 months of Warinner's and Zubkoff's uninterrupted time will be required to adequately digest, interpret, and draft the results from hydrographic, energetic and phytoplankton studies. Two Tech B's will be required to carry out laboratory analyses.

In order to accomplish the above, a Marine Scientist or another available scientist is needed immediately to keep a normal flow of operations in the Physiology Department while this work is completed.

We recommend that Dr. James Short of the University of Louisville be hired at this time to permit the completion of these data by Zubkoff and Warinner.

Zooplankton identifications will require approximately one year of effort by a qualified zooplanktologist. Two technicians (A-level) are needed immediately for sorting. Approximately 3 months of Grant's time will be needed to interpret and write results.

SUMMARY

The Plankton Program

Operation AGNES

Introduction

The zooplankton and plankton physiology projects within the NSF-RANN study of Chesapeake Bay (VIMS) had been conducting studies of the lower Bay and lower York River, respectively, for approximately one year prior to the arrival of Hurricane Agnes. Our respective studies were cooperative and connected, but only loosely so in that our study areas were not identical. We were, however, in a unique position to combine efforts in a study of the effects of Hurricane Agnes. A zooplankton survey was actually interrupted by the arrival of Agnes, thereby providing data immediately prior to flood conditions that was available for later comparisons.

Vessel demands by VIMS in carrying out flood studies necessitated our combining efforts during late June and July. Those measurements that had been routinely made by the plankton physiology group were added to zooplankton sampling over the lower Bay, thereby providing synoptic measurements of water temperature, salinity, dissolved oxygen, light transmission, dissolved nutrients, phytopigments, potential productivity and heterotrophy, phytoplankton identity and enumeration, zooplankton biomass, zooplankton identity and enumeration, zooplankton biochemistry.

Those stations occupied by the zooplankton group on the interrupted cruise of 19-20 June 1972 were revisited by our

combined groups at weekly intervals on the following dates:

June 29-30

July 6-7

July 13-14

New sets of randomly-chosen stations, covering a somewhat wider area, were sampled by this same combined plankton group on July 24-27 and August 14-17. It is our intention to continue to conduct monthly sampling over the lower Bay in this combined fashion.

Other Flood-Related Studies

In addition to the above efforts, zooplankton samples have been collected at station R15 on the Rappahannock River with a Miller sampler for comparison with large-mesh nets used by the Ichthyology Department in assessment of effects on fish eggs and larvae.

Offshore collections were obtained for us by Norcross and Ruzecki on July 19-20 using Miller samplers, and Zubkoff participated in a cruise of the Ridgely-Warfiled during which he obtained estimates of heterotrophic potential and hydrographic data.

Availability of Results

Certain of our observations are available for tabulation and analysis almost immediately; others require a small amount of processing before use, while some will require many months of work prior to their interpretation. Those that are now available,

Table 1. Integrated Plankton Study Parameters

Hydrography

- Temperature
- Salinity
- Dissolved Oxygen
- Light Transmission
- Solar Radiation

- Nutrients
  - Nitrate
  - Nitrite
  - Ortho Phosphate

Energetics

- Phytopigment
- Primary Productivity Potential
- Heterotrophic Productivity Potential

Phytoplankton

- Identification
- Counts

Zooplankton

- Preliminary Sorting
- Final Sorting

- Settled Volume
- Dry Weight
- Ash Weight
- Total Lipid
- Total Protein
- DNA

such as hydrographic observations, productivity and heterotrophic potentials, and pigment analyses, are appended to this report and are complete.

We have also included tabulations for data that are not so complete, but may be useful in showing trends and effects. These include phytoplankton and zooplankton enumerations. Such incomplete data must be viewed with caution, however, in drawing conclusions regarding flood effects. Other data is not yet available in any form, but must await further analyses. Included here are zooplankton dry weights, ash weights and biochemical constituents. Specific identity of zooplankters is also relatively remote at this time.

General Observations on Flood Effects

Before entering a discussion of what remains to be done, it would be well to comment on some of precautions in interpretation of results alluded to above. The interrupted cruise of 19-20 June showed the annual peak in populations of the ctenophore *Mnemiopsis leidyi*. This June maximum is well known from the work of V. G. Burrell at this laboratory and is known to decimate the crustacean plankton population. A decrease in copepods and cladocerans in late June and early July is therefore to be expected, and may not be attributed to flood effects.

Beroe ovata, another ctenophore, normally moves into the bay in July and preys on *Mnemiopsis*, thereby allowing the crustacean zooplankton population to increase. This sequence of events

DATES OF

LOWER CHESAPEAKE BAY STATIONS

	York River (Mouth)	Lower Bay							
		A	B	C	D	E	F	G	H
June	26	-	-	-	-	-	-	-	-
	28	30	30	29	29	29	29	-	-
July	6	7	7	6	6	6	6	-	-
	13	14	14	13, 14	13	13, 14	13	-	-
	27	26, 27	26	26	24	24, 27	24, 25	24, 25	24, 2
August	3	-	-	-	-	-	-	-	-
	21	15, 17	17	15, 17	15, 21	15, 21	18, 21	18, 21	18

Bay Mouth to Continental Shelf

27 July - 3 August

occurred despite Agnes, and in just the time period that could lead to misinterpretation. Examination of copepod and cladoceran numbers (Appendix) shows a decimation coinciding with the influx of flood waters and a subsequent slow buildup that could be interpreted as recovery from flood effects. However, this may, as pointed out above, be the normal and annual course of events.

One possible result of the flood waters was an intense bloom of *Rhizosolenia* in the lower Bay for approximately 10 days. This diatom provided a streaked appearance to the water surface, clogged plankton nets and was very evident in zooplankton samples. A second possibility is a slower recovery in copepod populations following the *Mnemiopsis - Beroe* cycle. Biomass estimates of zooplankton in August 1972 are considerably below those of August 1971.

Further Work

Much of the flood work was carried out by personnel assigned to the RANN projects. The necessary but frequent and long hours spent on the water by these people have slowed progress on RANN work. This can only be reversed by adding personnel.

In the zooplankton program, sorting of samples was nearly current just prior to the flood. We are now 2 months behind in the sorting. Although 2 summer aides were hired for sorting flood samples, their period of employment was too short to prevent a postponing of RANN sorting, or even to complete sorting of most of the flood samples. They did sort 65 Clarke-Bumpus samples, all from the flood study.

Flood-related samples still awaiting a sorter include some 43 Bongo samples, 68 Clarke-Bumpus samples, 29 offshore Miller samples, and the innumerable Rappahannock River collections.

Laboratory aspects of the plankton physiology program have likewise suffered from this additional and expanded effort. Drying and biochemical analyses of zooplankton are at a near standstill from the lack of technicians to carry out analyses.

Our combined operation will require the equivalent of 4 additional technicians on a full-time basis to bring these studies to completion. Technicians should be A-level for zooplankton sorting and B-level for chemical analyses. Such an increase in man-hours would enable us to conclude this study in 6 months to 1 year.

SECTION III

James, York and Rappahannock River Trawl Survey
(Agnes Flood) June 28-July 3, 1972

James:

Catches were good in lower James with spot, spotted hake, hogchoker and croakers the most abundant species. A few of the following were also caught: common searobins, gray trout, black sea bass, bay whiff, cusk eels, bay anchovys, tongue fish, oyster toads, silver perch, whitting, summer flounder, windowpane flounder and American eel. A fair number of crabs were also taken. In the upper stations JA 20 - JA 36 catches were much lighter than I expected. A few of the following were caught: channel cats, hogchoker, spottail shiners, white cats, blueback herring, alewife, American eels, white perch, German carp, banded croaker, brown bullheads and hogchokers. A few spot taken were very nice size for this time of year (up to 224 mm). Most hogchokes were taken below JA 25, with only 1/2 dozen or so above there. Temperature, salinity and oxygen were taken at surface, midwater and bottom at each station. Station JA-000 through JA-036 were sampled.

York:

Catches were fair in lower York (Y-025 to mouth) with spot, croakers, hogchokers and bay anchoveys the most abundant species. A few of the following were also caught: summer flounder, silver perch, gray trout, oyster toads, common searobins, striped bass, spotted hake, banded croaker, tongue fish, black sea bass, menhaden, striped searobin, American eel, white perch, white cats and alewife. A good number of crabs were also taken. In the upper stations YP 30 - YP 50 catches were very light, with a few of the following taken; white cats, hogchokers, white perch, channel cats, American eel, spottail shiner, and red horse sucker. Again most hogchokes were taken on YO-25 and below with only a few taken above YO-25. Temperature, salinity and oxygens were taken at surface midwater and bottom at each station. Station YP-000 through YP-050 were sampled.

Rappahannock River:

Catches were fair in the middle to lower Rappahannock (RA-025 - to mouth) with spot and hogchokes the most abundant species. A few of the following were also caught; gray trout, summer flounder, bay anchovy, oyster toads, American eel, winter flounder, croakers, spotted hake, alewife, puffer, common searobin, menhaden, black sea bass, white cats and white perch. In the upper stations RA-35 and RA-40 catches were very light, with a few of the following taken: white cats, white perch, hogchoker, American eel, alewife. Again most hogchokes were taken in lower river but some were taken in upper stations. Temperature, salinity and oxygens were taken at

surface, midwater and bottom at each station. A fair number of crabs were taken. Station RA-000 through RA-040 were sampled.

Remarks:

In each river system a 30' semi-balloon bottom trawl (unlined) was used. Tows were made for 7-1/2 minutes. Most of the fish taken seem to be in the lower rivers. Very few catfish were taken on any of the river stations we sampled. It appeared to me the catches were lighter than they should be for this time of year.

Woodrow Wilson
Chief Scientist
R/V Langley

York River Bottom Salinity, Temperature and Oxygen Readings for Agnes and Agnes Follow-up Trawl Survey, 1972

Station	Date	Salinity	Temperature	Oxygen
YO-000	June 29	15.36	23.20	5.67
YO-000	Aug. 21	25.55	23.20	1.17
YO-005	June 29	16.36	23.00	3.19
YO-005	Aug. 21	23.93	23.40	1.41
YO-010	June 30	11.30	23.50	4.32
YO-010	Aug. 21	20.21	24.80	0.81
YO-015	June 30	8.33	23.10	3.10
YO-015	Aug. 22	17.24	24.90	1.52
YO-020	June 30	6.13	24.00	4.84
YO-020	Aug. 22	14.82	25.50	2.42
YO-025	June 30	0.49	24.00	4.46
YO-025	Aug. 22	12.80	25.60	3.09
YP-030	June 30	0.05	22.60	4.04
YP-030	Aug. 22	7.10	27.00	4.55
YP-035	June 30	0.05	22.00	4.60
YP-035	Aug. 22	1.73	26.20	5.12
YP-040	June 30	0.09	22.00	4.30
YP-040	Aug. 23	0.07	25.30	6.16
YP-050	June 30	0.06	22.20	5.13
YP-050	Aug. 23	0.07	26.80	7.47

Rappahannock River Bottom Salinity, Temperature and Oxygen Reading for Agnes and Agnes Follow-up Trawl Survey, 1972

Station	Date	Salinity	Temperature	Oxygen
RA-000	July 2	8.91	24.00	8.91
	Sept. 7	12.27	23.30	7.19
RA-005	July 2	10.72	23.50	2.88
	Sept. 7	13.53	23.90	2.10
RA-010	July 3	10.33	22.50	2.60
	Sept. 7	13.18	23.40	3.26
RA-015	July 3	10.27	22.00	2.56
	Sept. 6	12.76	24.00	2.89
RA-020	July 3	10.07	23.00	2.44
	Sept. 6	11.09	24.40	3.36
RA-025	July 3	7.47	24.00	2.44
	Sept. 6	10.16	23.30	6.42
RA-030	July 3	4.57	24.00	3.58
	Sept. 6	6.72	23.50	5.89
RA-035	July 3	0.06	25.50	5.97
	Sept. 6	2.49	21.60	7.79
RA-040	July 3	0.06	26.00	6.35
	Aug. 30	1.21	26.80	

Rappahannock River Bottom Salinity, Temperature and Oxygen Reading for Agnes and Agnes Follow-up Trawl Survey, 1972

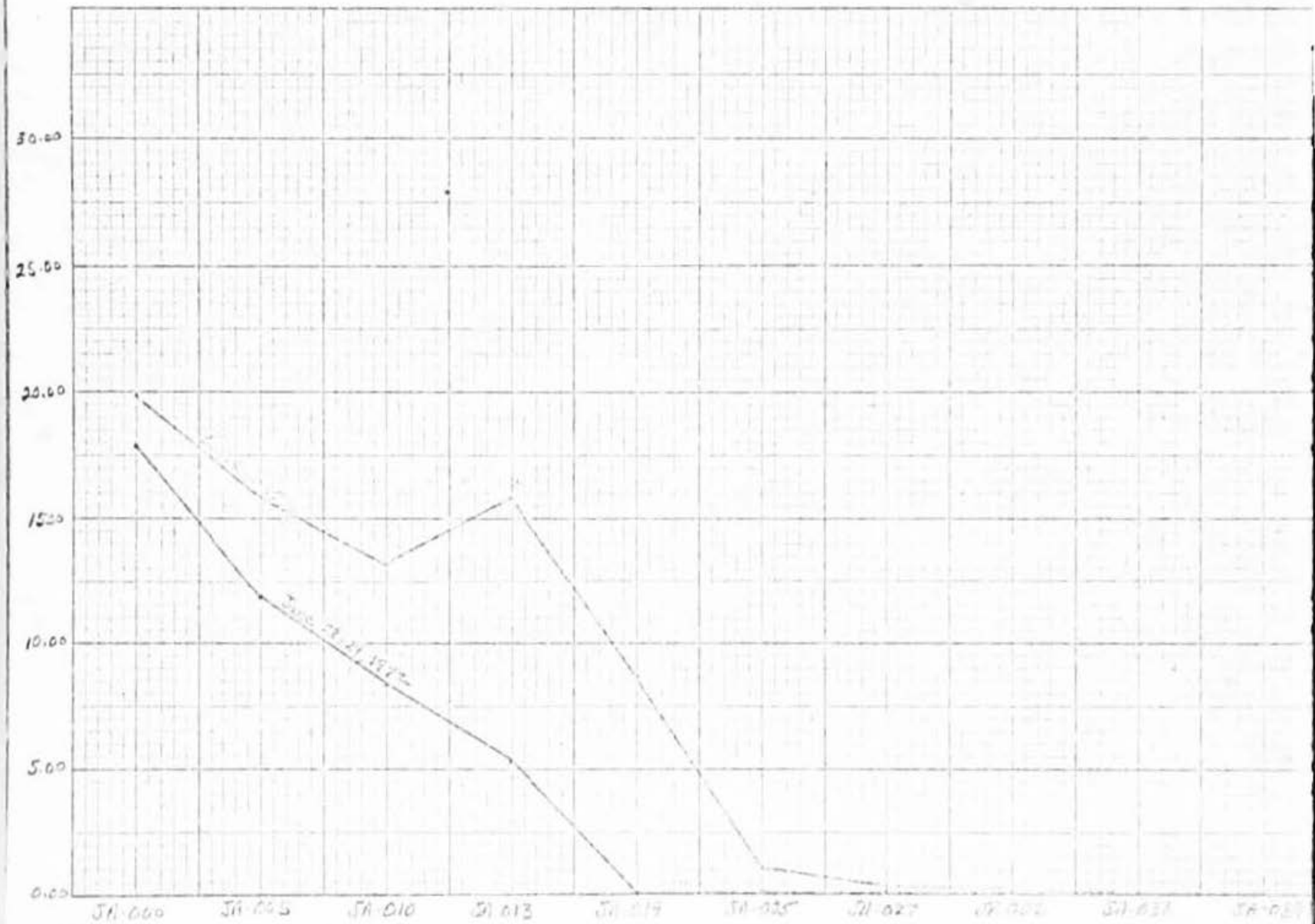
Station	Date	Salinity	Temperature	Oxygen
RA-000	July 2	8.91	24.00	8.91
	Sept. 7	12.27	23.30	7.19
RA-005	July 2	10.72	23.50	2.88
	Sept. 7	13.53	23.90	2.10
RA-010	July 3	10.33	22.50	2.60
	Sept. 7	13.18	23.40	3.26
RA-015	July 3	10.27	22.00	2.56
	Sept. 6	12.76	24.00	2.89
RA-020	July 3	10.07	23.00	2.44
	Sept. 6	11.09	24.40	3.36
RA-025	July 3	7.47	24.00	2.44
	Sept. 6	10.16	23.30	6.42
RA-030	July 3	4.57	24.00	3.58
	Sept. 6	6.72	23.50	5.89
RA-035	July 3	0.06	25.50	5.97
	Sept. 6	2.49	21.60	7.79
RA-040	July 3	0.06	26.00	6.35
	Aug. 30	1.21	26.80	

Tides for Agnes and Agnes Follow-up Trawl Survey, 1972

Station	Agnes	Agnes Follow-up
JA-000	Flood	Ebb
JA-005	Flood	Flood
JA-010	Ebb	Flood
JA-013	Ebb	Flood
JA-019	Ebb	Flood
JA-025	Ebb	Flood
JA-027	Ebb	Ebb
JA-032	Flood	Ebb
JA-036	Flood	Ebb
JA-039	Flood	Ebb
YO-000	Ebb	Ebb
YO-005	Ebb	Ebb
YO-010	Ebb	Ebb
YO-015	Ebb	Flood
YO-020	Ebb	Flood
YO-025	Flood	Flood
YP-030	Ebb	Ebb
YP-035	Ebb	Ebb
YP-040	Ebb	Ebb
YP-050	Ebb	Flood
RA-000	Flood	Flood
RA-005	Flood	Flood
RA-010	Ebb	Flood
RA-015	Ebb	Flood
RA-020	Ebb	Flood
RA-025	Ebb	Flood
RA-030	Ebb	Flood
RA-035	Ebb	Ebb
RA-040	Ebb	Flood

James River Bottom Salinity, Temperature and Oxygen Readings for Agnes and Agnes Follow-Up Trawl Survey, 1972

Station	Date	Salinity	Temperature	Oxygen
JA-000	June 29	17.95	21.60	5.47
JA-000	Aug. 8	19.94	25.50	5.60
JA-005	June 29	11.89	22.00	5.63
JA-005	Aug. 9	15.90	25.00	5.66
JA-010	June 29	8.43	22.00	5.05
JA-010	Aug. 9	13.22	26.50	5.66
JA-013	June 28	5.36	21.90	4.74
JA-013	Aug. 15	15.89	25.00	4.70
JA-019	June 26	0.07	21.30	5.47
JA-019	Aug. 9	8.63	26.50	6.07
JA-024-25	June 28	0.06	22.00	5.39
JA-024-25	Aug. 9	1.19	27.00	6.71
JA-027	June 28	0.07	22.20	5.43
JA-027	Aug. 9	0.40	28.50	7.28
JA-032	June 28	0.07	23.20	5.65
JA-032	Aug. 9	0.21	28.50	6.36
JA-036	June 28	0.06	22.00	5.83
JA-036	Aug. 10	0.16	26.00	6.67
JA-039	Aug. 10	0.16	25.50	6.42



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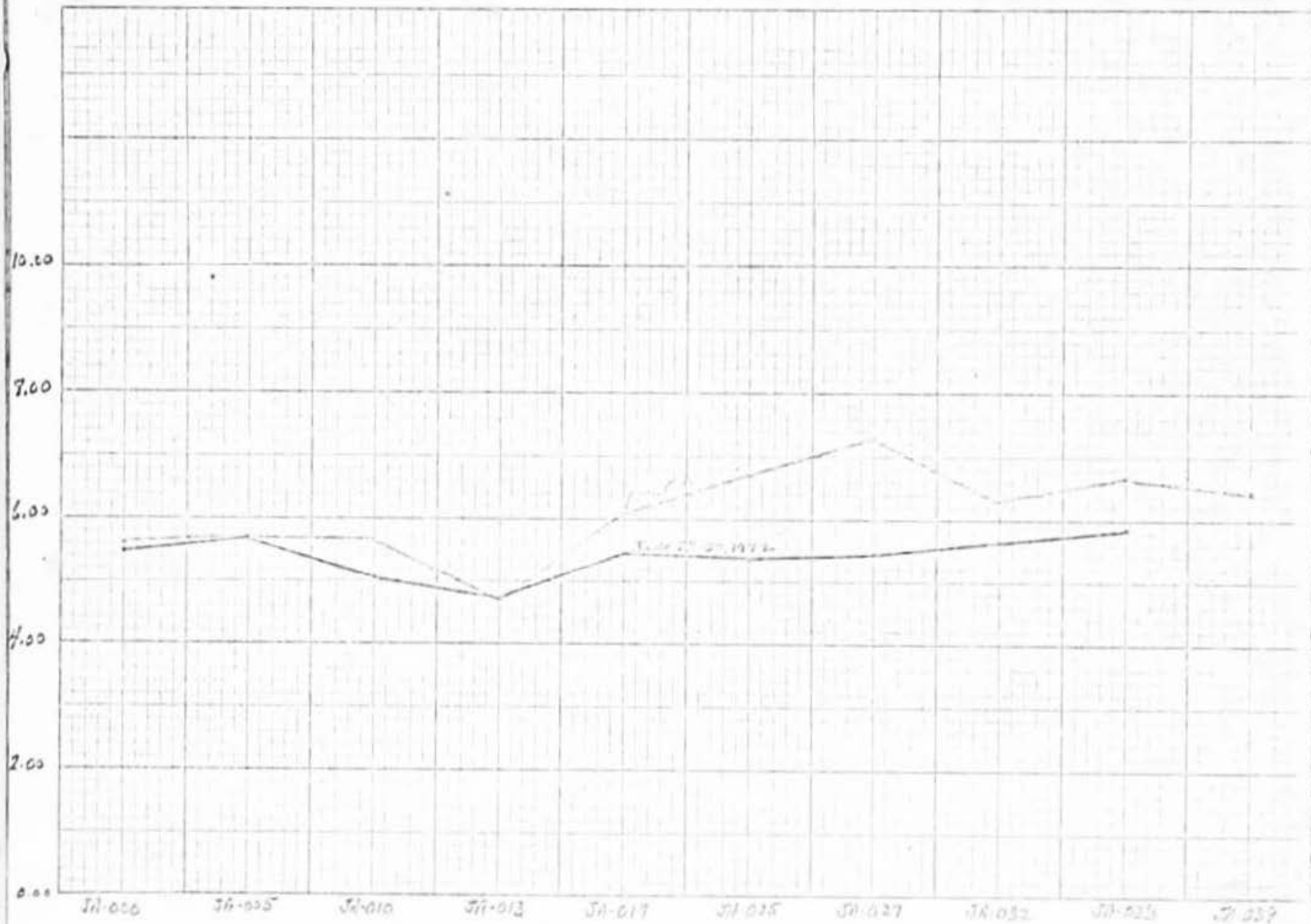
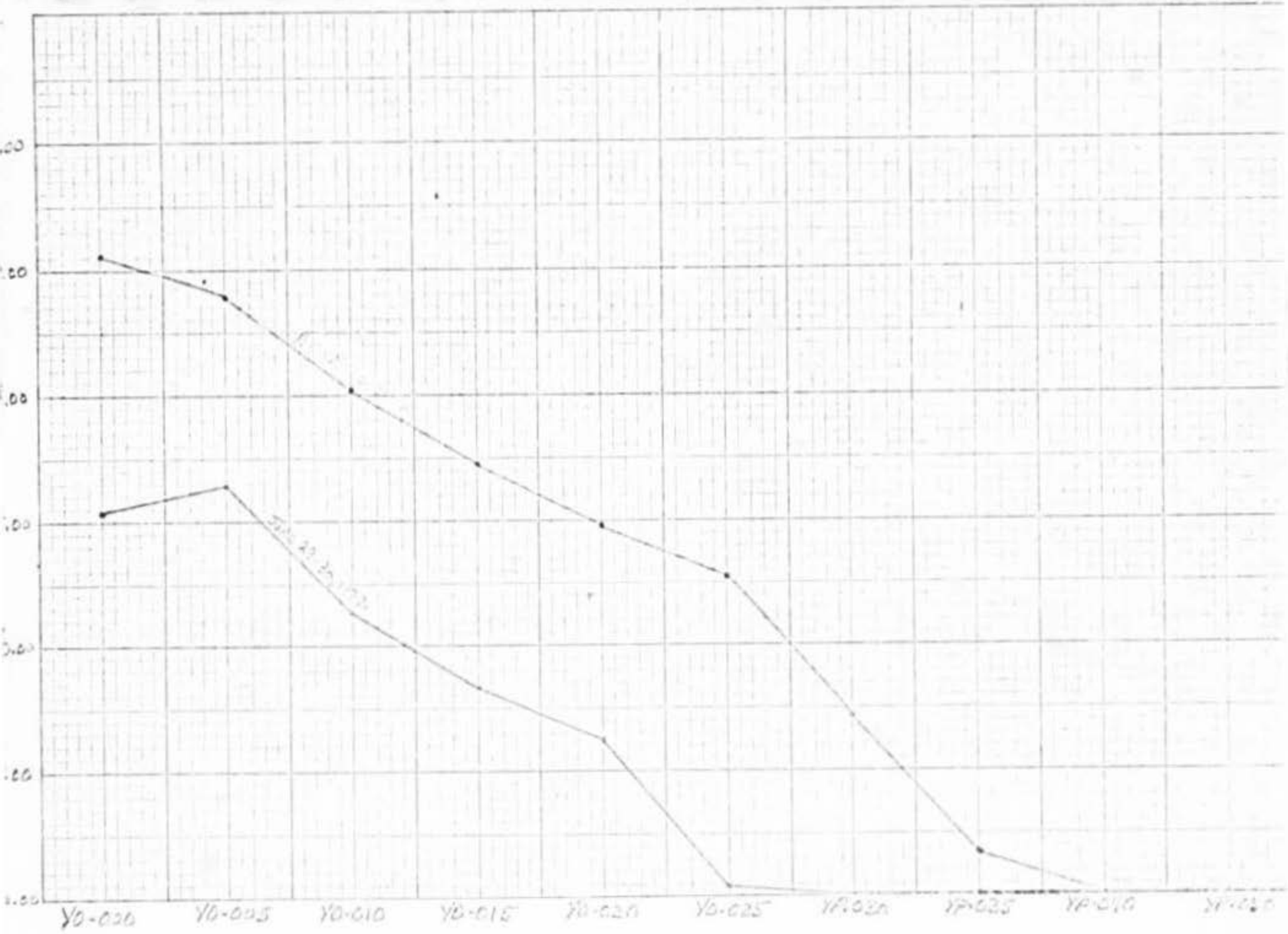


BLACK June 28-29 Just after Flood



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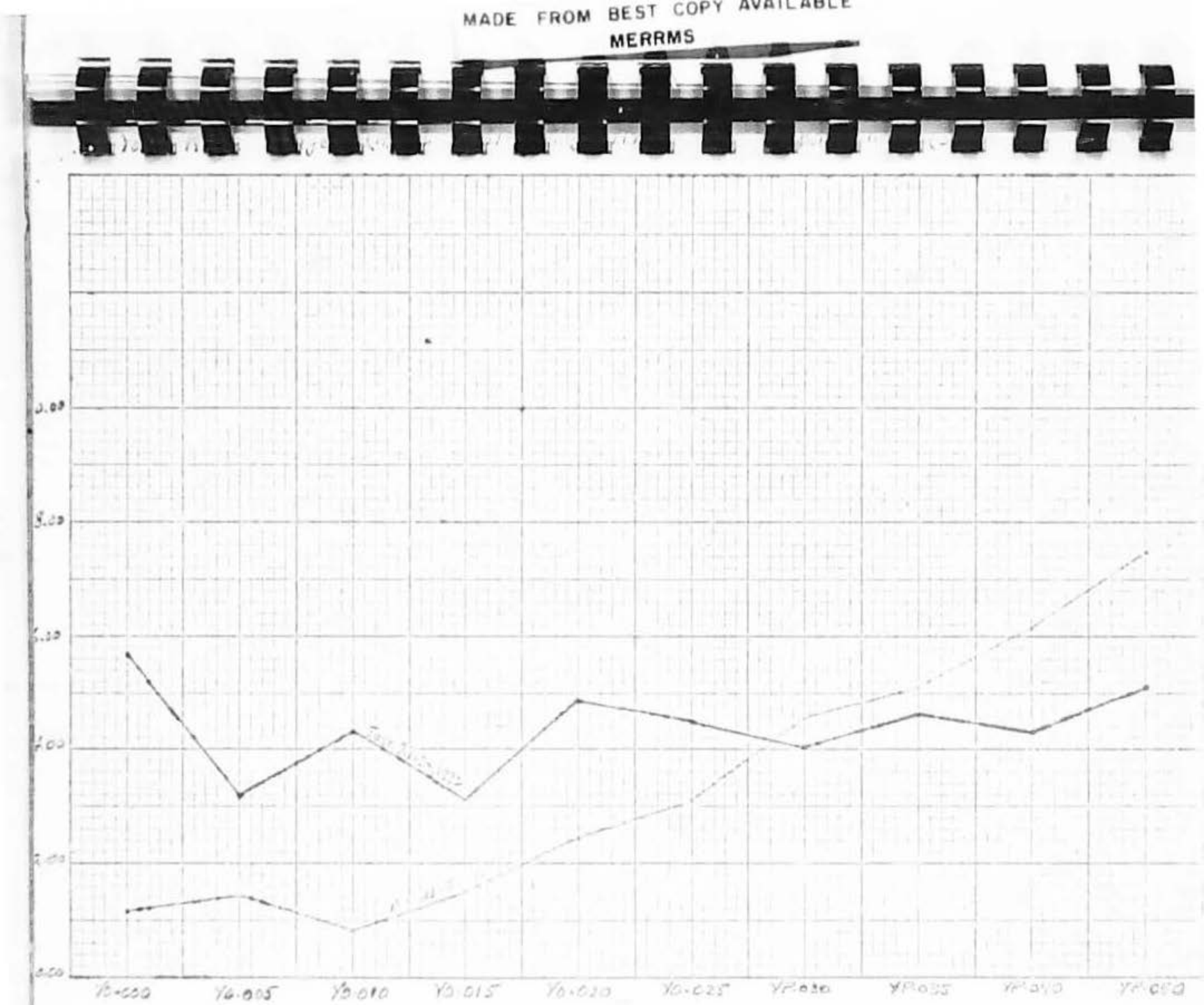
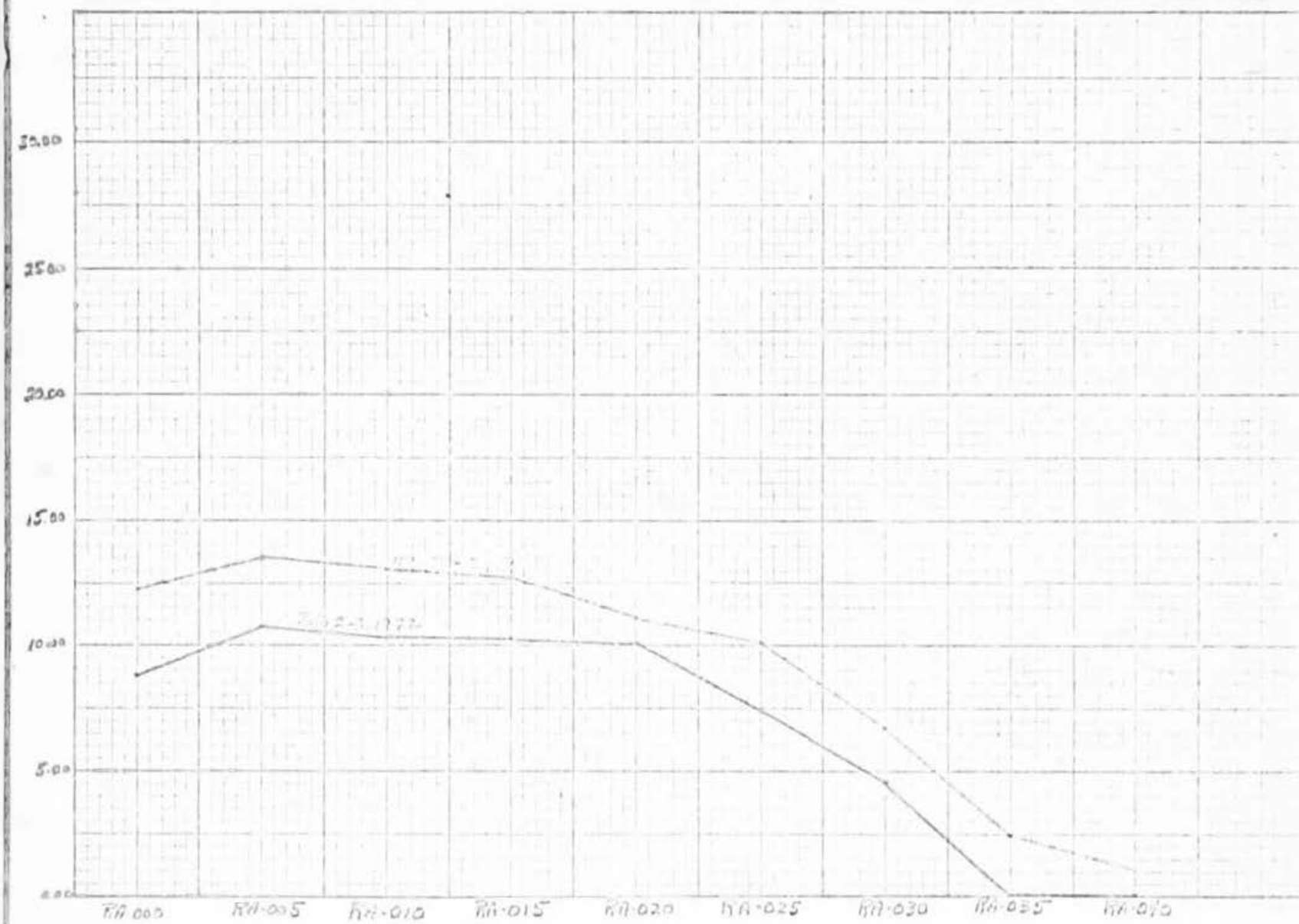
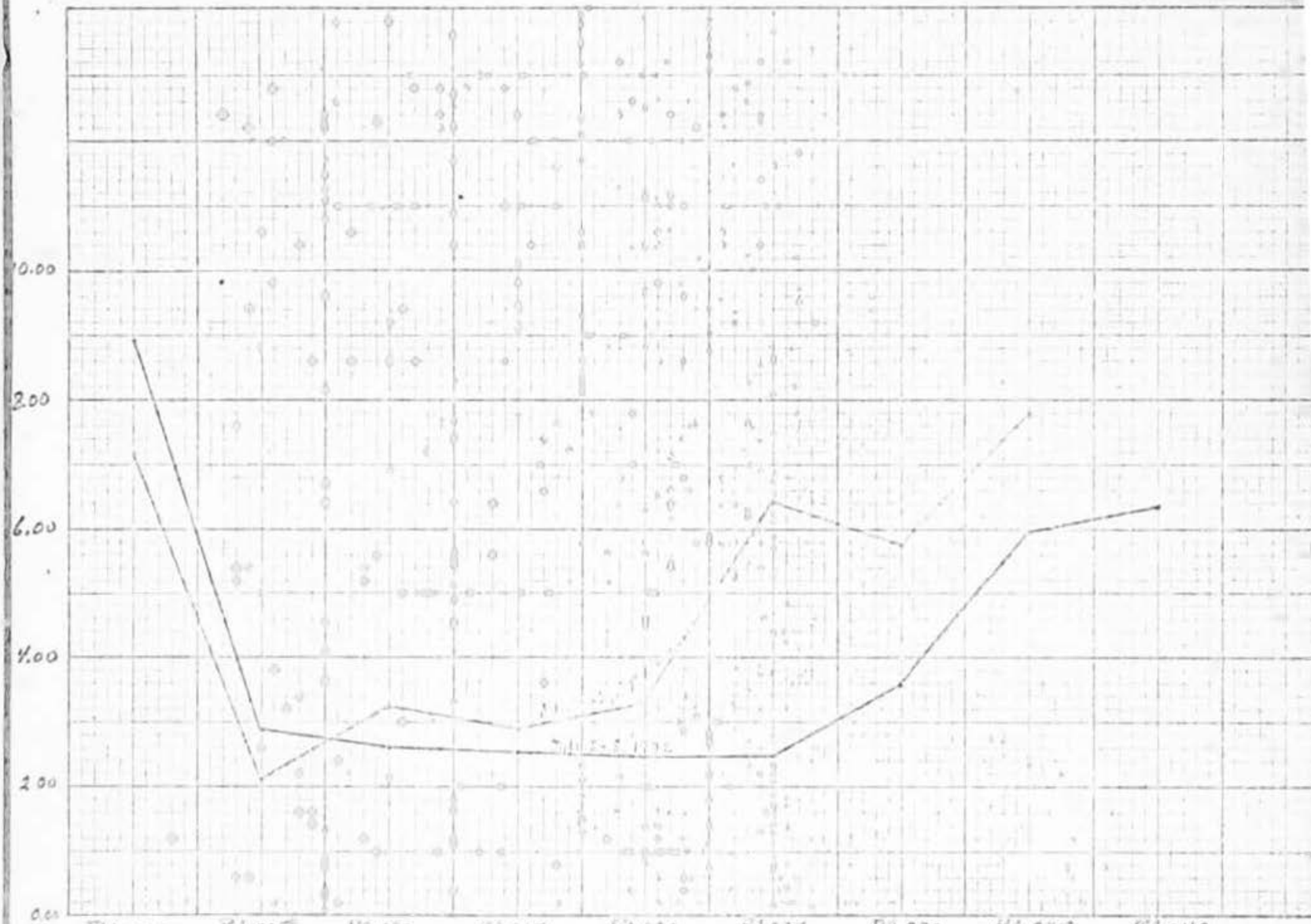


Blank Sand 27-30 - Just after Flood



Black July 2-3 - Just after flood



HURRICANE AGNES, FINFISH INVESTIGATIONS

UP TO SEPT. 7, 1972

W. Hogman

I. Work Completed

Samples were taken of larval fish being washed out of the Rappahannock and James rivers June 24 to July 15, 1972. These samples were quantitatively obtained from the anchor stations by suspending a one meter plankton net for 10 minutes in the known flow rate. The Rappahannock provided 184 samples and the James 84, mostly taken at one hour intervals on ebb tide.

An intensive bottom trawl survey was conducted from June 28 to July 3 on the James, York and Rappahannock. Five replicate tows were made at three stations in each river, the mouth, the 8-12 ppt isohaline, and the 1-0 ppt zone. Between these stations a single tow was made at five mile intervals in all rivers.

A follow-up trawl survey using identical gear, vessel, stations and sampling plan was made between Aug. 9 and Sept. 7 for the three rivers.

II. Results

The larval samples have not been processed but casual observation indicates vast numbers were captured in the meter nets. If the samples are representative of larvae displacement over the entire river, for the top one meter, 45 to 80 million fish larvae may have been lost per day over the first several days in the Rappahannock. The James samples contained fewer larvae but samples with 50-200 were not uncommon. As the constant

ebb decreased the larval catches diminished in both rivers. Three weeks after Agnes struck, larval transport to Chesapeake Bay appeared over.

The bottom trawl survey provided evidence of downstream displacement of dermersal fishes. Between mile 20-36 in the James white catfish, channel catfish, German carp and brown bullheads were taken in addition to other fishes normally present. The York catches were inconclusive but probably because fresh water did not extend lower than mile 25-30. The Rappahannock showed some fish displacement, but catches were small from mile 25 to 40. The follow-up trawl survey just completed should provide more quantitative estimates of flood effects on bottom fishes.

SECTION IV

Survey of Fouling in York River
27 September 1972
J. D. Andrews

I spent 30 minutes of SCUBA on the downriver end of the same York Bridge caisson as in two previous dives. A flood current of nearly two knots prevented much work on the western sunny offshore side as before.

The tide was low and oysters, rope grass and ivory barnacles were quite evident in about 15 inches of lower intertidal zone -- up to bottom of heavy timber where shaded but only Chthamalus on the sunny lower end in this zone. Black and greenish blue greens were noticeable as before.

In the first meter or two there was no noticeable change. The ivory barnacles predominate with a few yearling oysters, tufts of rope grass and lots of large white sea anemones. A few single Mogula or small clusters were present. Anguinella was present at this level but increased with depth as did sea squirts and rope grass.

Sponges had increased in abundance and size of colonies -- both red and stinky. The lobes were mostly 1 to 2 inches high on both although I pulled off one clump of Microciona 4-5 inches long -- perhaps a surviving colony. The stinky sponge was compact, almost solid surfaced and filled with silt down at 15 to 20 ft. - a growth form differing from the lobed colonies (fingers) nearer the surface.

At the surface, I could clearly see that the rope grass was Carveia and apparently most of it at all depths was this but Dale Calder went through two buckets of my material and found Bougainvillia in the bridge collection. The sea squirts at depths were in flat or larger-sized groups and mostly hanging very loosely -- about ready to fall off and about full grown. I did not see anything new or any dramatic changes. Serpulids were present only as large old tubes probably without worms. Scattered older oysters were still there. The Carveia is thinning and tufts were shorter than earlier. It was not nearly as massive on the caisson as on stakes at Tillages and Aberdeen and as far up as Bell's Rock. Acanthodesia did not seem as conspicuous. Sponges were definitely increasing. No species except Lissodendoryx were seen of the yellows.

Collections of rope grass were taken at stakes and light supports at Tillages, Aberdeen Rock and Bell's Rock. Also the scarce red algae and rope grass caught in a fish trawl were collected. Carveia predominated at all stations with masses extending around stakes up to over a foot in diameter. There was bryozoan Acanthodesia growing at the base of masses particularly at Aberdeen where I was looking for the "new" bryozoan. I found the "fronds" at Aberdeen and after comparing with Acanthodesia on same masses have concluded that the fronds are simply an unusual growth form of this common encrusting species. The species look the same to me and I found Acanthodesia growing around stems of hydroid then sending out "fronds" without any core or stem for support. Apparently the chicken wire top of the Hampton Bar tray provided the substrate for the

1 to 2 inch erect fronds that we observed. Some Zooecia still contain live animals but many may be dead under the huge masses of rope grass.

As we went up river, the rope grass (all Garveia above the bridge) became more densely filled with large numbers of sea anemones -- small young ones that had set there but stretched out in the bucket this morning over an inch long and 3 to 4 mm in diameter. Amphipods were especially abundant at Bell's Rock and white-clawed Rithropanopeus were apparently abundant. Nudibranch eggs were very common strung thru the Garveia colonies. Both male and female colonies were seen with reddish spathes and bluish plannula larvae (single in gonozoids hence G. franciscana). A porous irregular-shaped mass of crystalline case (?) was common on the stems of Garveia -- no spicules in a smear). Neither Dr. Wass nor Dale Calder could identify.

TO: Dr. Davis Status of Oysters in James 2 July 1972
Sunday
J. D. Andrews 1800

The prospect of saving James River seed oysters is markedly improved on this second Sunday and 10th day after Agnes runoff is known to have put the oyster beds under pressure.

Oysters on Wreck Shoal are known to have gotten a drink of salt water today and are feeding with styles on mid-flood tide at 1400. Barring Susequehanna sump problems that may come, it looks like the oysters on the tops of the best rocks will survive at the Wreck Shoal level on the left side of channel on down.

There is improvement in salinity regimes today over previous runs (of my crew) at low slack water. The haliclines are shallower and much less steep although the upper half of the seed area is still under low-salinity or freshwater stress most of the day.

Rather few new deaths have occurred at any level of the river on the tops of rocks (where 0^2 is least likely to become a problem and smothering by silt is minimized). New boxes occur commonly at Deep Water Shoal and sparingly at Horsehead. The oysters are holding on against low salinity although often weak. Color of oysters and shell is ok except for clayey coat.

Very important are the winds of two rough Fridays and even more so the return of normal tides. Last Sunday there was no flood tide. Today we saw a below average low tide (level) and a strong flood tide on the left side of the river at least.

The salt water is returning in the seed area if the sump doesn't go fresher. We found up to 9 ppt salinity at lower edge of Wreck Shoal bar where flood tide pushes over the bar in 10 ft of water.

There are no 0^2 problems in James that we can detect although the sampler (Frautsch) bottles for sampling have been consistently badly prepared for 0^2 samples. We annealed a tube to outlet last Sunday with matches, and taped one on today (no matches). Apparently others are taking 0^2 samples without tubes to the bottom of sample bottles! Terrible! Borrowed equipment is lost or misused equipment usually!

Please note that I am not at this time looking in sloughs and swashes for smothering and dead oysters -- my aim now is to pin down kills by low salinities without other complications.

11d

19 July 1972

J. D. Andrews

One month after Agnes dropped her floodwaters, there have been remarkably small losses of oysters in the James River seed area. The end of the pressure on oyster populations has not been reached. Weather (hot and calm or rainy) and complications (low oxygens) may yet arise. The latest trend is strong stratification (thermal and salinity) that could lead to complications of low oxygens. The appearance of a strong salt wedge (15‰ at Nun 12) in the channel is encouraging if we could get some strong winds to mix it into surface waters.

The oysters in the lower half of the seed area -- Wreck Shoal and downriver have fed several times to our knowledge and should not be threatened now by low salinities. Above Wreck Shoal, we have no evidence of feeding since our first sampling on 23 June 1972. In this upper sector salinities have been consistently below 5 ppt at the level of oyster beds, even during flood tides, and usually closer to 0 salinity.

Deep Water Shoal now shows over 60% dead oysters on the edge of the channel and worse losses inshore. There were few oysters left after the dredging two years ago and it must be written off as a total loss.

At the Horsehead level of the river, losses are greatest on the shallowest beds and those farthest away from channels. Losses at

levels of about 10% to 20% have increased very slowly over the past 10 days. Some new gapers and weak oysters (squirt and sound hollow when tapped) are seen on each trip however. A shallow bed off Mulberry Point opposite Horsehead has run about 30% dead the past week.

There may be losses on the shallow lumps in the Point of Shoals triangle pointing towards Burrell's Bay, but these beds are hard to locate and sample. At Point of Shoals on ridge along the old channel, and at Rainbow Rock behind Buoy #17, losses have been less than 5% consistently. A few fresh boxes are seen on upper Wreck Shoal in each lick.

A crude estimate of total losses of seed stock in the James River probably would not exceed 20% at this time and may be closer to 10%. The lower half appears reasonably safe from further damage but continued losses may be expected above Wreck Shoal from low salinities alone and could be aggravated on deeper beds by low oxygens

The low salinities for over a year have caused oysters to be poor and stunted, hence seed production may be expected to decline even if few more die. September 1971 set (nearly yearlings) looks like 1972 spat should.

Mortalities in James River

J. D. Andrews

F. Dead

Sample Beds

Date	Wreck Shoal	Rainbow	Horsehead*	Deep Water Shoal
25 Jun 72	0	-	2	22
27 Jun 72	0	-	1	16
2 Jul 72	0	-	3	2, 14
5 Jul 72	3	-	6	-
7 Jul 72	2	7	7	18, 22, 46
10 Jul 72	5	2	13	22, 62
14 Jul 72	3, 6	2	10, 17	40
19 Jul 72	6	4	5	62

* Where channel edge and inshore samples taken, the results are given in that order.

SCUBA on Inshore Wreck Shoal Shellplanting

(250,000 bu. planted in late July)

J. D. Andrews

21 August 1972

Both Curtis and I dived on the MRC shell planting inshore of Wreck Shoal. The planting is well marked by stakes and I was pulled by boat from offshore to inshore across it and back. The bottom is soft sand in this area with no shells or oysters at all. I began in bare sand offshore of the line of stakes and went to bare sand inshore of another line of stakes. Our diving indicated that the shells are mostly confined within the staked area.

My strongest impression is of the shells being covered with a coat of fine silt and detritus that fluffs up at the slightest motion. It was late ebb tide and the depth was 8 to 10 feet but current was not noticeable and visitility was good. There was no appreciable movement of silt near the bottom as I entered new areas being pulled behind the boat. One could use a "flush" board over the shell bed but the silt would settle right back on the shells. This accumulation of about a month cannot be removed in my opinion. I could see small spots of clean shell where crabs or mud toads had burrowed in the shells or where Curtis had been over the bottom. I saw an 18" catfish but recall no other living thing although this is not unexpected while being pulled along close to the bottom at about 1 mile per hour. Actually at times the shells began to blur at that speed and within a foot of the bottom. The silt coating was not stuck on the shells but after

this viewing, I can understand why shells planted during setting attain several times as many spat as early ones.

The distribution of shells on the plot appeared to be quite good, but this is to be expected with a heavy rate of planting. Occasionally shells were thin enough to see the sandy bottom but more commonly they were perhaps a foot deep. I would run a gloved hand into the shells seeking the bottom and find only shells. There were very few bare sand spots except near the borders of the planting. Occasionally I popped to the surface to report bare areas and see where I was, only to return to the bottom and find shells again -- while being towed. At the other extreme, both Curtis and I found shell banks two to three feet high and lower shell ridges were not uncommon. I could not explore the length of these ridges on my survey although Curtis stopped the boat and motor each of the dozen or two times I came up to report. These banks declined abruptly at their edges hence it was easy to see how high they were. These were not common in the middle of the plot and may represent turning or stopping of the barges although Curtis found a big one at the edge running up and down river and I found one running across the river.

Shells do not tend to sink in this sandy bottom although much of the planting is small shells and cinder which is ideal for quality of seed. Once in the 1950's, a small buy boat load of shell was planted even further inshore than this plot and it caught a set but became lost eventually. We were concerned that winter storms would sand over the shells but this plot is of a size that prohibits that although storms may move some shells -- there is nothing to attach

to in the bottom so only the weight of the shells protects them. This shell bed should persist for many years, especially if an oyster strike occurs to lock the shells in place. I emphasize this because it may take several years to obtain any appreciable number of oysters. I think it would be desirable to sprinkle seed oysters on top the shell planting to try to attract spatfalls. Earlier shell plantings in this vicinity (below) in the 1960's required several years before any appreciable spatfall occurred whereas nearby oyster "rocks" were getting better but still light sets.

This was an efficient shell planting from the standpoints of cost and objectives. I can't help but wonder what the effect would have been if this half-million bushels could have been scattered lightly over the producing oyster rocks. The method would have had to be altered drastically. At least a small control would have been informative. I'm afraid shellbags hung over the planting will not reflect the true value of the plantings. Some shellbags filled with the Maryland dredged shell and placed on the planting and offshore on Wreck Shoal may give some idea of the relative availability of setting larvae.

Some shell brought back appears to have no fouling yet, although a little "mud" is sticking to the shells. In normal years, I would say that this planting was a month early, but who wishes to go out on a limb with predictions this year. With low salinities and poor almost spawnless oysters, it would seem to take a miracle to get setting in August of 1972, but the stratified transport system now there is

usually found only in September when waters have cooled a little. I can't in all honesty criticize the heavy rate of planting in this area on sandy bottom. I would estimate that somewhere between 10 and 25% of the shell is exposed to setting -- probably closer to the lower figure. The James River differs from other seed areas in its growth characteristics and unfortunately in its setting potential in recent years. One must look upon these plantings as attempts to establish new seed beds. The choices of areas, if not the exact places, meets my approval. If we can be lucky enough to get a good strike, it will be acclaimed a great success. The shells should remain there many years. Our job is to monitor events on the plantings for a number of years. The commitments to shell planting in the James River have always been too little and half-hearted. This represents a major effort and must be followed accordingly.

SECTION V

Report on Hard Clam Populations in the Aftermath of Tropical Storm Agnes

by

Joseph G. Loesch and Dexter S. Haven

Department of Applied Biology

The investigation of hard clam populations was conducted on private and public grounds, and the results are separately summarized. Mortalities were first reported from private ground holders, possibly because the dense concentration in these substrates and floats was an additional stress factor. Subsequent to these investigations public ground sampling began and is presently being continued.

Mortality on private grounds was determined from the sample ratio of live hard clams to recent "boxes" (valves still attached by the hinge). On public grounds, because of the time lapse in which valves could be separated or move shoreward by wind driven currents, the physical condition of live hard clams was evaluated. Clams in very poor condition, and possibly dying, were recognized by the dark and flaccid state of the mantle and gills. Furthermore, the valves of these clams were easily separated, an impossible feat in healthy clams.

Private Grounds

Ferrin River

Shackelford-Schlifer Seafood Corporation. A 58 percent mortality was observed for hard clams planted in the natural substrate. Mortality was considerably higher, 82 percent, for clams held in floats.

York River

Conway Seafood Company: A 33 percent mortality occurred among Cherrystone and Chowder clams planted at a depth of 3.5 to 4 feet (MLW). Inshore at 2 to 3 feet in depth (MLW), 100 percent mortality occurred among 1000 bushels of Littleneck clams.

Poquoson

Hunt Seafood: Six different sites of Mr. Hunt's holding grounds were sampled and an overall mortality of 44 percent was estimated.

Roy E. Davis Company: There appeared to be approximately a 40 percent mortality among Mr. Davis hard clam holdings.

The above percentages are considerably higher than the normal 10 percent mortality generally realized in transporting and replanting hard clams.

Public Grounds

James River

All clams sampled from a depth of 20 feet or greater (MLW) appeared to be in healthy condition. All clams from the shoaler areas, such as the Middle Ground and Newport News Bar, however, were in a weak condition. A high mortality would probably occur if these clams were to be harvested, transported and then replanted. (It is mostly Hampton Roads clams purchased since August that are responsible for the high mortalities on the private grounds).

York River

Hard clams from deep-water samples in the York River appeared to be in good condition. In shoal water, weak clams constituted as high as 70 percent in one sample at Yorktown; and, overall, for the area

of Queen's Creek down to the Perrin River about 40 percent of the clams appeared weak and possibly dying.

Present and Future Investigations

Hard clam samples are presently being taken and evaluated in the area from New Point Comfort to Wolf Trap in Chesapeake Bay. The R/V Mar-Bel, crewed by J. Whitcomb, T. Kellum and D. Rowe, is used for this sampling.

In mid-October, 1972, we plan to remove the tow dredge and install the hydraulic escalator on the R/V Marbel in order to evaluate the soft clam populations in the Rappahannock River. Present catches will be compared with those taken with the same collection gear in 1968 and 1969.

Summary of Effects of Agnes on Oyster Populations in Virginia

by

Dexter Haven

Department of Applied Biology

7 September 1972

The Department of Applied Biology has spent much effort in following the influence of Agnes in the York, Rappahannock, Potomac and the Great Wicomico rivers. Effects in the James River were largely monitored by the Department of Malacology. Mortalities based on field counts by the Department of Applied Biology are summarized here.

Studies directed toward monitoring mortalities of oysters associated with fresh water on public and private oyster beds began on 23 June 1972. Monitoring consisted of visiting representative public and private oyster grounds at weekly intervals. During these visits, number of live, dying or dead oysters were recorded; salinity and temperature data were collected over the oyster beds. There follows a synopsis of the results by river system.

The James.

Number of surveys to date: 4.

Oyster mortality in this river system was confined to the upper-most public rocks. It was estimated that total mortality for the river was about 10%. Mortalities were over by 1 August. Mortality on private beds is now being studied but it is expected to be minimal.

The York.

Number of surveys to date: 9.

Oyster mortality to public grounds was negligible. Damage to oysters was largely confined to private leases in the upper river in the vicinity of Bells Rock. An estimated 2% of the oysters was killed in the entire York. Mortalities were over by late July.

The Rappahannock.

Number of surveys to date: 14.

Damage to oysters on public rocks in the Rappahannock was confined to Ross Rock, an unimportant rock in the upper river just below Tappahannock. Damage to oysters on private leases was extensive. Oysters began dying on 30 June with peak mortality occurring about 5 July. Mortalities were over by 14 August.

It is estimated that about 50 percent of the oysters on private leases in the Rappahannock died.

The area most seriously influenced extends on the south side of the river from 1/2 mile below Garrett's Marina to 3 miles above Garrett's Marina (the upper limit of oyster culture). In this zone the good oyster bottoms are located in from 4 to 6 feet (MLW). Mortalities here range from 65 to 100 percent. In this zone in deeper water, mortalities were lower. It is noted, however, that few leases are located in this latter region.

On the north side of the Rappahannock the mortality zone extends from [illegible] Point (about 3 miles below Tappahannock) to about 1 mile below Farnham Creek at depth of less than 6 feet (MLW). In this area mortalities ranged from about [illegible] to [illegible]%. At depth ranging from 6 to 10 feet, they were lower and ranged from about [illegible] to [illegible] percent. In

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On the north side of the Rappahannock the mortality zone extends from Accaceek Point (about 5 miles below Tappahannock) to about 1 mile below Farnham Creek at depth of less than 6 feet (MLW). In this area mortalities ranged from about 48 to 86%. At depth ranging from 6 to 10 feet, they were lower and ranged from about 19 to 34 percent. In

oysters in this region are planted at depths less than 14 feet (MLW).

Mortalities from fresh water were light to zero below Farnham Creek and 1/2 mile below Garrett's Marina with the single exception of one bed in shallow water near Jones Point.

The Potomac.

Number of surveys to date: 12.

The Potomac River suffered extensive damage to its oyster resource from Agnes. It was estimated that over 50% of the oysters on public bars in the entire river were killed.

Before Agnes hit the salinity in the upper Potomac had been very low for about 3 months and by mid June oysters on the upper bars had started to die. Therefore, the added fresh water associated with Agnes did extensive damage. The peak mortality occurred in the Potomac about 20 July 1972, and mortalities were largely over by the first week in August.

The mortality zone on the Virginia side extended from Colonial Beach to above the bridge. In this region mortality was nearly 100 percent. On the Maryland side, the zone of nearly 100 percent mortality extended from the 301 bridge to the mouth of the Wicomico River.

The Virginia Tributaries to the Potomac River.

Number of surveys to date: 7.

There was considerable damage to the oysters on public and private beds in the lower Machodoc Creek and in Nomini Creek.

In lower Machodoc Creek, up-river from Narrows Point, by 20 July 1972 from 60 to 75 percent of the oysters had died; down-river from Narrows

Point mortalities ranged from 17 to 43%. Low oxygen conditions developed on 22 August, and caused further mortalities.

In Nomini Creek mortalities ranged from 24 to 93 percent on 20 July 1972. Reports suggest that nearly all oysters are now dead due to a combination of low oxygen and fresh water.

Total Loss to Oyster Growers

It has been estimated by Pleasants and Haven that total dollar loss of market oysters by the oyster grower (value of crop when mature) is about $7,508,000.

Needed Work

What needs to be done in respect to oyster mortality is to prepare a manuscript which documents the progress of mortality in the rivers in relation to the salinity and temperature. The Department of Applied Biology should do this. Required for this is a print-out or summary of salinity and temperature data from the slack water runs in all rivers.

Oyster Setting.

Oyster setting has been monitored at 57 stations in Virginia since 19 June 1972. The work is a regular part of Applied Biology's duties, however, the results show that there has been an almost complete absence of set in almost all major river systems in Virginia with the exception of the Mobjack Bay region and the Seaside of the Eastern Shore. While cause and effect have not been demonstrated there is little doubt that the excessive fresh water run-off associated with Agnes is in some way associated with the absence of set.

It is noted that the three most important seed rivers, the James, the Great Wicomico and the Piankatank have not as yet received any set.

This is most unfortunate since if no set occurs this year then the supply of seed in 1973 will be limited at the time when demand will be at an all time high.

END